

Prompt Gamma-Ray Activation Analysis (PGAA) and Neutron Activation Analysis (NAA) with a Portable Neutron Generator

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An IAEA Coordinated research Project on the Development of a Database for Prompt Gamma-ray Activation Analysis (PGAA) was started in 1999 to evaluate thermal neutron capture gamma-ray energies and cross section yields. PGAA is a method of rapid, simultaneous, nondestructive total elemental analysis of almost any material. Its use has been limited by lack of a database and the requirement of a reactor-base facility. Most of our research on PGAA has been performed at the Budapest Reactor using their cold neutron beam.

Recently, members of the LBNL Accelerator and Fusion Research Division (AFRD) have been developing a portable neutron generator expected to produce $>10^{10}$ n/s by the D+D reaction. This reaction produces 2.5 MeV neutrons that can be moderated to thermal energies. The neutron flux at 25 cm from the neutron generator would be $>10^6$ n/s, comparable to the neutron intensity that was available at the Budapest Reactor. This distance would allow sufficient volume for moderator materials.

Initial experiments were performed at LBNL to test the feasibility of performing PGAA analysis with a neutron generator. A prototype neutron generator producing $\approx 10^7$ n/s was used with a 5 cm polyethylene moderator to perform the preliminary measurements. Gamma-ray spectra for various targets were recorded with a NOMAD Ge detector system. The PGAA spectrum for a borated polyethylene target is shown in Figure 1. The neutron flux was not sufficient to observe PGAA on lower cross section targets, but samples of Al, Cu, Ga, Hf, and Lu were irradiated and analyzed off-line by Neutron Activation Analysis (NAA). The NAA spectrum for Cu is shown in Figure 2.

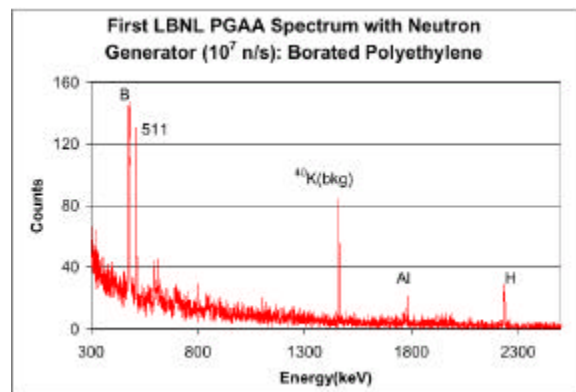


Figure 1. PGAA spectrum of borated polyethylene. The neutron intensity was too low to see the carbon.

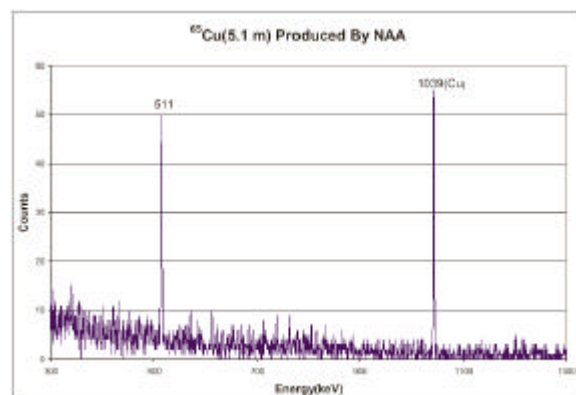


Figure 2. NAA spectrum of copper.

Footnotes and References

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